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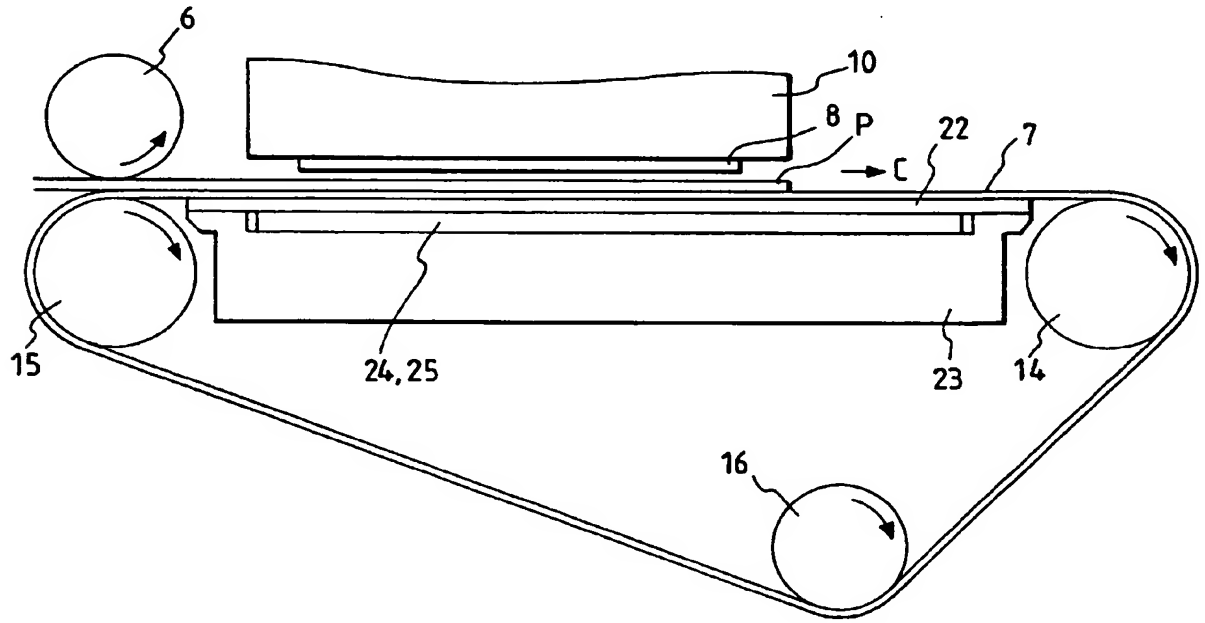
(54) Sheet convey apparatus

(57) The present invention provides a sheet convey apparatus comprising a belt-shaped convey means for supporting and conveying a sheet, and an absorbing force generating means disposed within the belt-shaped convey means for causing the sheet to be absorbed to the belt-shaped convey means. Wherein at least one of portions of the belt-shaped convey means and the absorbing force generating means contacted with each other is made of synthetic resin material having frictional coefficient μ smaller than 0.4 ($\mu \leqq 0.4$) and water-absorbing rate A smaller than 0.4% ($A \leqq 0.4\%$).

FIG. 1



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a sheet convey apparatus incorporated into a recording apparatus such as a copying machine, a printer and the like, and more particularly, it relates to a sheet convey apparatus incorporated into a recording portion of a recording apparatus of ink jet recording type.

Related Background Art

Conventionally, in sheet convey portions situated in recording areas of ink jet recording apparatuses, an arrangement has been provided for electrostatically absorbing a sheet (recording material to be recorded) to the convey portion and for conveying the sheet by the latter in order to prevent the sheet from floating toward a recording head or to prevent the sheet from wetting (with moisture in ink) and weaving (referred to as "cockling") when the ink is discharged onto the sheet. In particular, when an elongated recording head is used, since there is a large amount of area of a front surface of recording surface of the sheet which cannot be held by paper holder plate(s) to prevent the floating of the sheet, the electrostatic absorbing means for absorbing a back surface of the sheet toward the convey portion is effective to prevent the floating of the sheet.

An example of a sheet convey apparatus having the above-mentioned electrostatic absorbing means is shown in Fig. 4. An endless convey belt 51 for absorbing and conveying a sheet P is disposed in a recording area opposed to a recording head 50. Within the convey belt 51, there are disposed a drive roller 52 for driving the belt 51, and a driven roller 53 for applying a tension force to the belt 51. A convey roller 54 is urged against the driven roller 53 at an upstream side of the recording head 50 in a sheet conveying direction, so that the sheet P is conveyed onto the convey belt 51 by the convey roller.

Further, in the recording area opposed to the recording head 50, within the convey belt 51, an electrode protection film 55 is urged against the convey belt 51 and is secured to an electrode support plate 56 by welding or other suitable means. Below the electrode protection film 55, there are disposed an electrode plate 57 formed from a conductive metal plate and an earth plate 58, these plates being secured to the electrode support plate 56 by welding or other suitable means. The electrode plate 57 and the earth plate 58 have comb-shapes, respectively, so that legs and recesses of the comb of one of the plates are alternately engaged by recesses and legs of the comb of the other plate. Positive or negative voltage is applied to the electrode plate 57, and the earth plate 58 is connected to earth or ground.

When the voltage is applied to the electrode plate 57, an electrostatic absorbing force is generated in the convey belt 51 through the electrode protection film 55, with the result that the sheet P is absorbed to the convey belt 51, thereby preventing the sheet P from floating toward the recording head 50 in the recording area.

However, in the above-mentioned conventional example, when the voltage is applied to the electrode plate 57, the electrostatic absorbing force for absorbing the sheet P onto the convey belt 51 is generated in the convey belt 51, and, at the same time, an electrostatic absorbing force is generated between the electrode protection film 55 and the convey belt 51. That is to say, the electrode protection film 55 and the convey belt 51 are absorbed to each other in a contact area therebetween. In this condition, since the convey belt 51 is absorbed to the electrode protection film 55, a torque for shifting the convey belt 51 in the sheet conveying direction is increased, thereby causing a risk of stoppage of a drive motor. To avoid this risk, a motor for providing a higher torque must be used, which results in increase in a dimension of the apparatus and in cost.

Further, if sliding resistance of the convey belt 51 due to the electrostatic absorbing force becomes greater than a frictional conveying force of the drive roller 52, slip is generated between the drive roller 52 and the convey belt 51, thereby causing poor sheet conveyance or unstable sheet conveyance.

When the sheet P is rested on the convey belt 51, the sheet P is electrostatically absorbed toward the electrode plate 57. Thus, since the convey belt 51 is subjected to the absorbing force for absorbing the belt to the electrode protection film 55 and a force (from the sheet P) for urging the convey belt against the electrode plate 57, the sliding resistance of the convey belt 51 is further increased in the absorbing portion.

The electrostatic absorbing force is varied in accordance with specific volume resistance (Ωcm) of the members (the electrode protection film 55 and the convey belt 51) in the absorbing force generating portion. In particular, the specific volume resistance will be greatly changed if the wetted conditions of the members are changed due to the change in humidity. Thus, under a high humidity condition, the members are well wetted to decrease the specific volume resistance thereof, thereby increasing the absorbing force. As the absorbing force is increased, the sliding resistance of the convey belt 51 is further increased, thereby causing the problem that the drive torque for the drive roller 52 is increased.

On the other hand, under a low humidity condition, the members are dried to increase the specific volume resistance thereof, thereby decreasing the absorbing force. As the absorbing force is decreased, the floating of the sheet P cannot be prevented by the absorbing force. As a result, the sheet P is contacted with the recording head 50, thereby causing the clogging of nozzles in the recording head and/or deterioration of an image (distortion of image and/or smudge of imaged surface).

SUMMARY OF THE INVENTION

An object of the present invention is to provide a sheet convey apparatus which can eliminate the above-mentioned conventional drawbacks, can generate a stable sheet absorbing force regardless of change in environmental conditions and can maintain high sheet conveying accuracy, and a recording apparatus which can provide a high quality image stably by using such a sheet convey apparatus.

In order to eliminate the above-mentioned conventional drawbacks, the present invention provides a sheet convey apparatus comprising a belt-shaped convey means for supporting and conveying a sheet, and an absorbing force generating means disposed within the belt-shaped convey means and adapted to cause the sheet to be absorbed to the belt-shaped convey means, and wherein at least one of portions of the belt-shaped convey means and the absorbing force generating means which are contacted with each other is made of synthetic resin material having frictional coefficient μ smaller than 0.4 ($\mu \leqq 0.4$) and water-absorbing rate A smaller than 0.4% ($A \leqq 0.4\%$).

A recording apparatus according to the present invention comprises the above-mentioned sheet convey apparatus, and a recording means for recording an image on the sheet conveyed by the sheet convey apparatus, in response to image information.

With the arrangement as mentioned above, in the sheet convey apparatus, since at least one of the portions of the belt-shaped convey means and the absorbing force generating means contacted with each other is made of synthetic resin material having frictional coefficient μ smaller than 0.4 ($\mu \leqq 0.4$) and water-absorbing rate A smaller than 0.4% ($A \leqq 0.4\%$), the stable sheet absorbing force can be generated regardless of the change in the environmental conditions. Further, since sliding resistance of the belt-shaped convey means can be decreased at an absorbing force generating portion, a drive source can be made compact and power consumption can be reduced, thereby reducing the cost. Further, since the sliding resistance of the belt-shaped convey means is decreased, slip between the belt-shaped convey means and a drive roller can be eliminated, thereby maintaining high sheet conveying accuracy.

Further, in the above-mentioned recording apparatus, by using the above-mentioned sheet convey apparatus, high accurate sheet convey ability can be maintained to provide a high quality image stably.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a side view of a sheet convey apparatus according to the present invention;

Fig. 2 is a sectional view showing a schematic construction of a recording apparatus;

Fig. 3 is a perspective view showing an inner construction of the sheet convey apparatus; and

Fig. 4 is a side view of a conventional sheet convey apparatus.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Now, a sheet convey apparatus and a recording apparatus according to a preferred embodiment of the present invention will be explained. In this embodiment, an ink jet printer will be described as an example. Fig. 1 is a side view of a sheet convey apparatus, Fig. 2 is a sectional view showing a schematic construction of a recording apparatus, and Fig. 3 is a perspective view showing an inner construction of the sheet convey apparatus.

First of all, the schematic construction of the ink jet printer will be explained with reference to Fig. 2.

In Fig. 2, the printer comprises a sheet supply tray 1 on which a plurality of recording sheets P are stacked, and a sheet supply roller 2 for separating and supplying the sheets stacked on the sheet supply tray 1 one by one. A separation pad 3 is disposed in a confronting relation to the sheet supply roller 2 so that, when the sheet supply roller 2 is rotated, an uppermost sheet P alone can be fed out in a downstream direction. Sheet guides 4, 5 serve to guide the sheet P supplied by the sheet supply roller 2 in a direction shown by the arrow B, thereby directing the sheet between a convey roller 6 and a convey belt (belt-shaped convey means) 7.

A recording head (recording means) 8 serves to record an ink image on the sheet P conveyed by the convey roller 6 and the convey belt 7. In this printer, the recording means is comprised of an ink jet recording type wherein ink is discharged from a recording head to form an image on a sheet. That is to say, the recording head includes fine liquid discharge openings (orifices), liquid passages, energy acting portions disposed within the liquid passages, and energy generating means for generating liquid droplet forming energy acting on the liquid in the energy acting portions.

Such energy generating means for generating the energy may be of type in which electrical/mechanical converters such as piezo-electric elements are used, or of type in which liquid is heated by illuminating an electromagnetic wave such as laser to discharge a liquid droplet due to the heating action, or of type in which liquid is heated by an electrical/thermal converter such as a heating element having a heating resistive body to discharge the liquid.

Among the recording methods, in a recording head used in the ink jet recording method for discharge the ink by means of the thermal energy, since high density liquid passage arrangement (arrangement of discharge openings with high density) for discharging the ink and for forming ink droplets can be achieved, it is possible to perform the recording with a high resolving power. Among them, the recording heads using the electrical/thermal converters as the energy generating means can be easily made compact, can make use of the advantages of

IC techniques and micro-working techniques which have recently been remarkably progressed in the semi-conductor field, can easily be mounted with high density and can be made cheaper.

An ink tank 9 serves to supply ink to the recording head 8. The recording head 8 and the ink tank 9 are mounted on a main scan carriage 10 which can be reciprocally shifted along a recording direction (perpendicular to the plane of Fig. 2). The main scan carriage 10 is supported and guided by guide rails 11, 12, and a driving force is transmitted from a drive source (not shown) to the carriage through a belt so that the carriage is reciprocally shifted in a recording area while rolling rollers 13 on the guide rail 12.

The convey roller 6 is urged against a driven roller 15 disposed within the convey belt 7 by a biasing means (not shown). The convey belt 7 serves to absorb the supplied sheet P and to convey the sheet to a recording position. The convey belt 7 is mounted around a drive roller 14, the driven roller 15 and a tension roller 16, and is shifted in a direction shown by the arrow C by rotating the drive roller 14 by a drive source. The tension roller 16 is rotatably supported on a free end of pressure arms 17 (only one of which is shown) pivotally mounted on an electrode support plate 23 via a pin 23a. By biasing the pressure arms 17 by means of pressure springs 18 (only one of which is shown), the convey belt 7 is subjected to a tension force via the tension roller 16. The convey belt 7 comprises an endless belt having a thickness of about 0.1 - 0.2 mm and made of synthetic resin such as polycarbonate, polyethylene, fluororesin or the like.

A discharge roller 19 is rotated by a drive source. Spurs 20 are urged against the discharge roller 19 and is rotated by rotation of it. Since the spurs 20 are designed to be contacted with a recorded surface of the sheet P, they are made of material to which the ink is not adhered (for example, plastic, stainless steel or the like). The sheet P is conveyed by the discharge roller 19 and the spurs 20 and discharged onto a discharge tray 21.

Next, an absorbing force generating means will be explained with reference to Figs. 1 and 3.

In Fig. 1, an electrode protection film 22 is disposed in contact with an inner surface of the convey belt 7 and is secured to the electrode support plate 23 by welding or other suitable means. The electrode protection film 22 comprises a film member having a thickness of about 0.1 - 0.2 mm and made of synthetic resin such as polycarbonate, polyethylene, fluororesin or the like (similar to that of the convey belt 7). Below the electrode protection film 22, there are disposed an electrode plate 24 and an earth plate 25 which are formed from conductive metal plates and which are secured to the electrode support plate 23 by welding or other suitable means.

Now, the electrode plate 24 and the earth plate 25 will be fully explained.

As shown in Fig. 3, the electrode plate 24 and the earth plate 25 have comb-shapes, respectively, so that legs and recesses of the comb of one of the plates are alternately engaged by recesses and legs of the comb of the other plate. Positive or negative voltage of about 0.5 - 10 kV is applied from a high voltage source (not shown) to the electrode plate 24, and the earth plate 25 is connected to earth or ground. When the voltage is applied to the electrode plate 24, an electrostatic absorbing force is generated in the convey belt 7 through the electrode protection film 22, thereby preventing the sheet P from floating toward the recording head 8 in the recording area.

Next, the convey belt 7 and the electrode protection film 22 will be fully explained. The convey belt 7 and the electrode protection film 22 each has frictional coefficient μ smaller than 0.4 ($\mu \leq 0.4$) and water-absorbing rate A (change ratio in weight after 24 hours under a temperature of 23°C) smaller than 0.4% ($A \leq 0.4\%$) and each is made of synthetic resin such as polycarbonate, polyethylene, fluororesin or the like.

By selecting the frictional coefficient μ smaller than 0.4 ($\mu \leq 0.4$), sliding resistance in a contact area between the convey belt 7 and the electrode protection film 22 can be reduced. Thus, the convey belt 7 can be moved by low torque without any slip between the belt and the drive roller 14, thereby achieving high accurate sheet conveyance stably. Further, a drive motor for driving the drive roller 14 can be made compact, thereby reducing the manufacturing cost of the apparatus.

By selecting the water-absorbing rate A smaller than 0.4% ($A \leq 0.4\%$), the change in specific volume resistance can be reduced. For example, when the specific volume resistance under a low humidity (10%) condition is 10^a Ωcm and the specific volume resistance under a high humidity (90%) condition is 10^b Ωcm, the change in specific volume resistance can be suppressed to about $(a-b) \leq 3$, change in the absorbing force under the low and high humidity conditions can be reduced, and the predetermined absorbing force can be generated stably. That is to say, as the frictional coefficient μ and the water-absorbing rate A are decreased, the effects obtained thereby are improved. In particular, regarding fluororesin such as PTFE, FEP, high density polyethylene and polypropylene, the frictional coefficient μ becomes smaller than 0.3 ($\mu \leq 0.3$) and the water-absorbing rate A becomes smaller than 0.01% ($A \leq 0.01\%$), thereby providing the excellent effect. Accordingly, in the ink jet printer, since the high accurate sheet conveying ability can be obtained, it is possible to provide a high quality image stably.

(Other Embodiments)

Materials from which the convey belt 7 and the electrode protection film 22 are made are not limited to the above-mentioned example, but, any material having frictional coefficient μ smaller than 0.4 ($\mu \leq 0.4$) and water-absorbing rate A smaller than 0.4% ($A \leq 0.4\%$) may be used. Further, in the above-mentioned embodiment, while an example that both the frictional coefficient μ and the water-absorbing rate A are considered was explained, since the sliding resistance of the convey belt

7 can be reduced under the condition of $\mu \leq 0.4$ and the change in the specific volume resistance can be reduced under the condition of $A \leq 0.4\%$ to achieve the effects that the predetermined absorbing force can be obtained stably and such effects can be provided independently, only one of these features may be used.

Furthermore, in the above-mentioned embodiment, while an example that both the convey belt 7 and the electrode protection film 22 have the features regarding the frictional coefficient and the water-absorbing rate was explained, either the convey belt 7 or the electrode protection film 22 may have the above features.

In addition, in the above-mentioned embodiments, while an example that the ink jet recording head is used as the recording means was explained, it is more preferable that the recording means is designed so that the ink is discharged from the discharge opening to effect the recording by growth and contraction of a bubble in the ink formed by the film boiling caused by thermal energy generated from an electrothermal converter energized in response to a record signal.

Although this system can be applied to both a so-called "on-demand type" and "continuous type", it is more effective when the present invention is particularly applied to the on-demand type, because, by applying at least one drive signal corresponding to the record information and capable of providing the abrupt temperature increase exceeding the nucleate boiling to the electrothermal converters arranged in correspondence to the sheet or liquid passages including the liquid (ink) therein, it is possible to form a bubble in the liquid in correspondence to the drive signal by generating the film boiling on the heat acting surface of the recording head due to the generation of the thermal energy in the electrothermal converters. Due to the growth and contraction of the bubble, the liquid is discharged from the discharge opening to form at least one liquid droplet. When the drive signal has a pulse shape, since the growth and contraction of the bubble can be quickly effected, more excellent liquid charge can be achieved.

Further, the present invention can be applied to a recording head of full-line type having a length corresponding to a maximum width of a recording medium to be recorded. As such a recording head, the construction wherein such a length is attained by combining a plurality of recording heads or a single recording head integrally formed may be adopted.

In addition, among the above-mentioned serial types, the present invention is effectively applicable to a recording head secured to a carriage, or a removable recording head of chip type wherein, when mounted on a carriage, electrical connection between it and the recording system and the supply of ink from the recording system can be permitted, or to a recording head of cartridge type wherein a cartridge is integrally formed with the recording head itself.

Further, it is preferable that a head recovery means and an auxiliary aiding means are added to the recording head according to the present invention, since the effect of the present invention is further improved. More particularly, these means include a capping means for capping the recording head, a cleaning means, a pressurizing or suction means, and an auxiliary heating means comprising electrothermal converters or other heating elements or combination thereof. Further, it is effective for the stable recording to perform an auxiliary discharge mode wherein the ink discharge not relating to the recording ink discharge is effected.

Further, as to the kind and number of the recording heads to be mounted, each recording head may correspond to each different color ink, or a plurality of recording heads can be used for a plurality of inks having different colors and/or different densities. That is to say, for example, the present invention can effectively be applied not only to a recording mode with a single main color such as black, but also to a system providing a plurality of different colors and/or a full-color by mixing colors by using an integrated recording head or combination of plural recording heads.

Furthermore, in the illustrated embodiments, while the ink was liquid, the ink may be solid in a room temperature or less and softened or liquidized at the room temperature. In the ink jet recording systems, since the temperature control is generally effected in a temperature range from 30°C to 70°C so that the viscosity of the ink is maintained within a stable discharging range, the ink may be liquidized when the record signal is emitted. In addition, ink having a feature that is firstly liquidized by the thermal energy, such as solid ink which serves to prevent the increase in temperature by absorbing energy in changing the ink from the solid state to the liquid state or which is in the solid state in the reserved condition to prevent the vaporization of the ink and which is liquidized by application of the thermal energy into liquid ink to be discharged in response to the record signal, or ink which has already been solidified upon reaching the recording medium, can also be applied to the present invention.

Further, the aforementioned ink jet recording printer may be used as image output terminals of information processing systems such as computers or may be used with a copying machine incorporating a reader therein or a facsimile system having transmission/receiver function.

As mentioned above, according to the present invention, in the sheet convey apparatus, since at least one of the portions of the belt-shaped convey means and the absorbing force generating means which are contacted with each other is made of synthetic resin material having frictional coefficient μ smaller than 0.4 ($\mu \leq 0.4$) and water-absorbing rate A smaller than 0.4% ($A \leq 0.4\%$), the stable sheet absorbing force can be generated regardless of the change in the environmental conditions. Further, since sliding resistance of the belt-shaped convey means can be decreased at an absorbing force generating portion, a drive source can be made compact and power consumption can be reduced, thereby reducing the cost. Further, since the sliding resistance of the belt-shaped convey means is

decreased, slip between the belt-shaped convey means and a drive roller can be eliminated, thereby maintaining high sheet conveying accuracy.

Further, in the above-mentioned recording apparatus, by using the above-mentioned sheet convey apparatus, high accurate sheet conveying ability can be maintained to provide a high quality image stably.

The present invention provides a sheet convey apparatus comprising a belt-shaped convey means for supporting and conveying a sheet, and an absorbing force generating means disposed within the belt-shaped convey means for causing the sheet to be absorbed to the belt-shaped convey means. Wherein at least one of portions of the belt-shaped convey means and the absorbing force generating means contacted with each other is made of synthetic resin material having frictional coefficient μ smaller than 0.4 ($\mu \leqq 0.4$) and water-absorbing rate A smaller than 0.4% ($A \leqq 0.4\%$).

Claims

1. A sheet convey apparatus comprising:
   a belt-shaped convey means for supporting and conveying a sheet; and
   an absorbing force generating means disposed within said belt-shaped convey means for causing the sheet to be absorbed to said belt-shaped convey means;
   wherein at least one of portions of said belt-shaped convey means and said absorbing force generating means contacted with each other is made of synthetic resin material having frictional coefficient μ smaller than 0.4 ($\mu \leqq 0.4$) and water-absorbing rate A smaller than 0.4% ($A \leqq 0.4\%$).

2. A recording apparatus comprising:
   a sheet convey apparatus according to claim 1; and
   recording means for recording an image on the sheet conveyed by said sheet convey apparatus, in response to image information.

3. A recording apparatus according to claim 2, wherein said recording means is of ink jet recording type in which ink is selectively discharged from a plurality of nozzles in response to the image information to effect the recording.

4. A recording apparatus according to claim 3, wherein said recording means is an electric/thermal converter capable of generating thermal energy for discharging the ink.

5. A recording apparatus according to claim 4, wherein said recording means is of type in which the ink is discharged from said nozzle by utilizing film boiling caused in the ink by the thermal energy.

6. A sheet convey apparatus comprising:
   a belt for supporting and conveying a sheet; and
   an absorbing force generating means for causing the sheet to be absorbed to said belt;
   wherein at least one of said belt-shaped convey means and said absorbing force generating means is made of synthetic resin material having water-absorbing rate A smaller than 0.4% ($A \leqq 0.4\%$).

7. A sheet convey apparatus according to claim 6, wherein a portion of said belt contacted with said absorbing force generating means is made of synthetic resin material having water-absorbing capacity A smaller than 0.4% ($A \leqq 0.4\%$).

8. A sheet convey apparatus according to claim 6, wherein a portion of said absorbing force generating means contacted with said belt is made of synthetic resin material having water-absorbing rate A smaller than 0.4% ($A \leqq 0.4\%$).

9. A sheet convey apparatus comprising:
   a belt for supporting and conveying a sheet; and
   an absorbing force generating means for causing the sheet to be absorbed to said belt;
   wherein at least one of said belt-shaped convey means and said absorbing force generating means is made of synthetic resin material having frictional coefficient μ smaller than 0.4 ($\mu \leqq 0.4$).

10. A sheet convey apparatus according to claim 6, further comprising a plurality of rollers for supporting said belt.

11. An image forming apparatus comprising:
    a sheet convey apparatus according to claim 6; and
    an image forming means for forming an image on the sheet conveyed by said sheet convey apparatus.

12. An image forming apparatus according to claim 11, wherein said image forming means forms the image on the sheet by discharging ink.

13. An image forming apparatus according to claim 12, wherein said image forming means discharges the ink by utilizing thermal energy.

FIG. 1

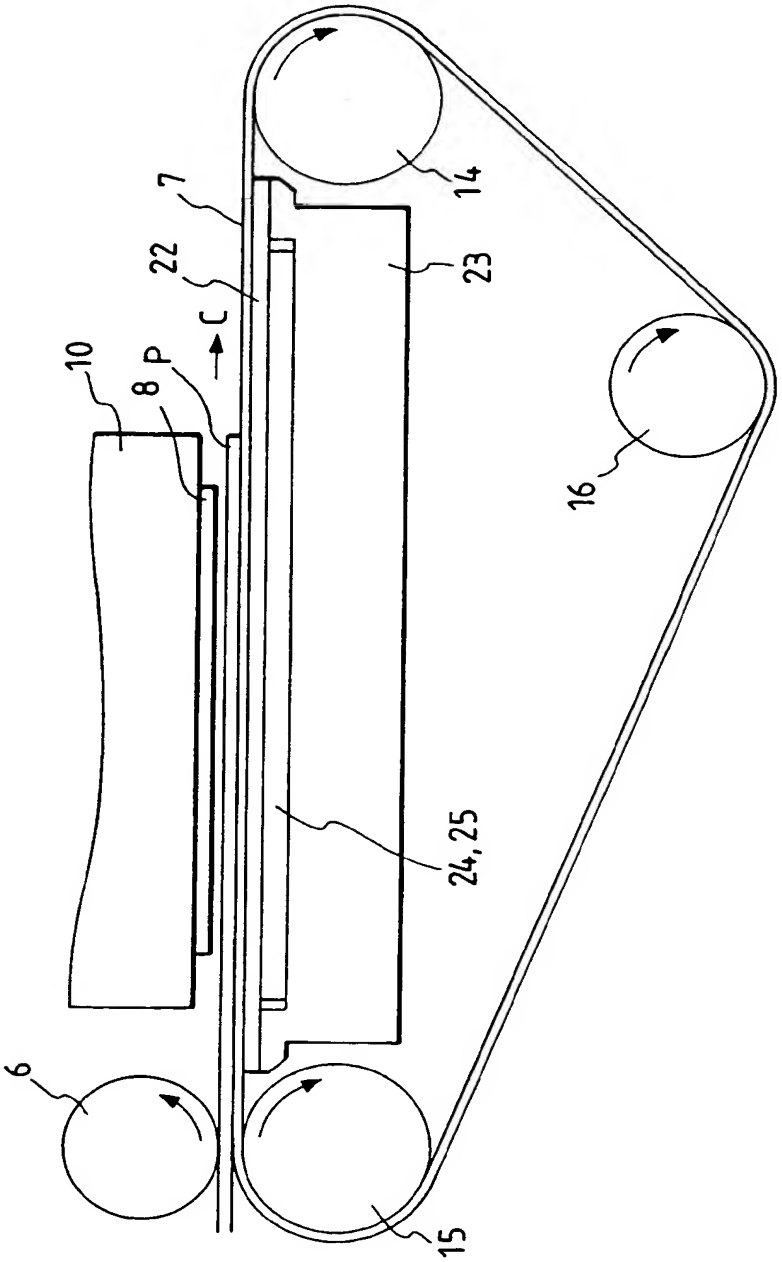


FIG. 2

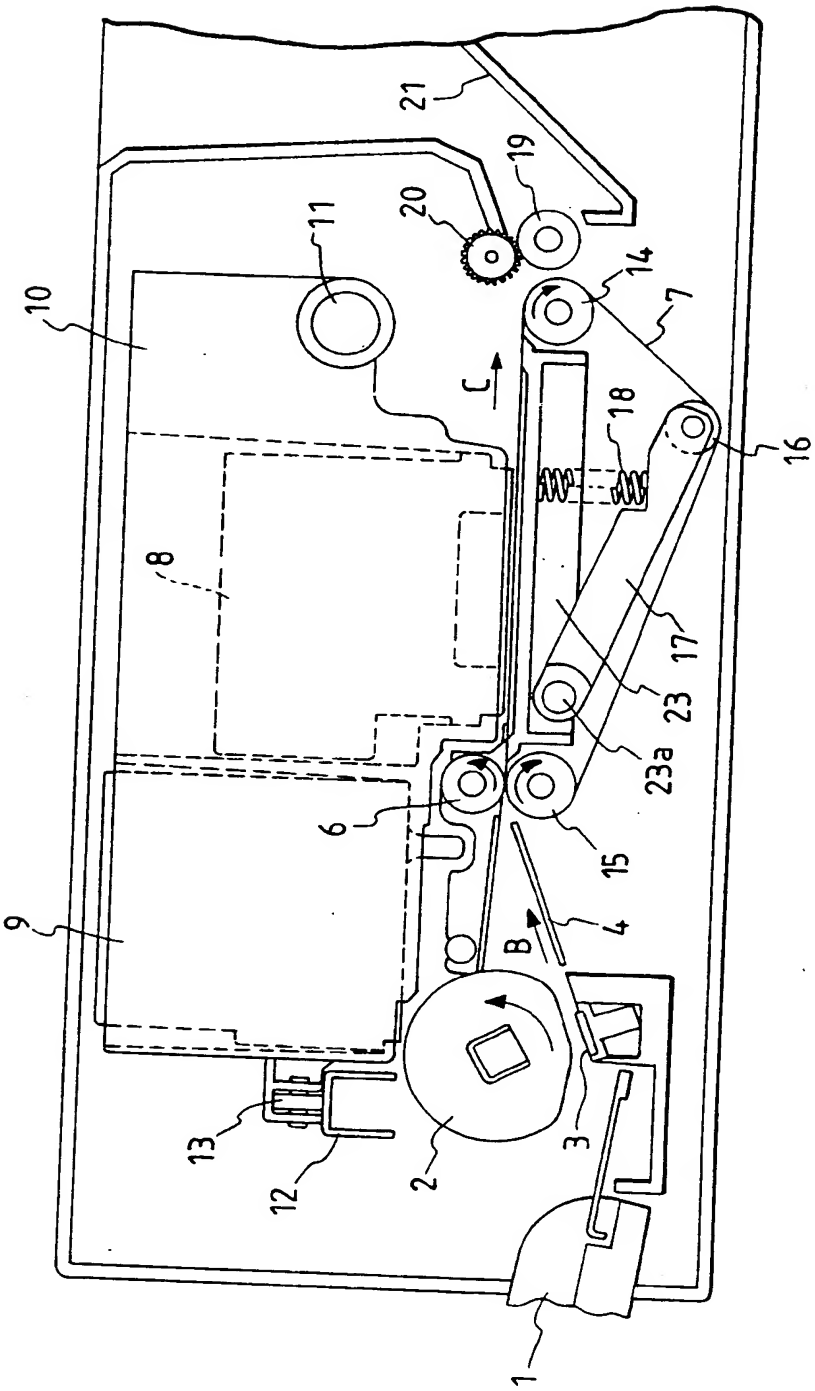
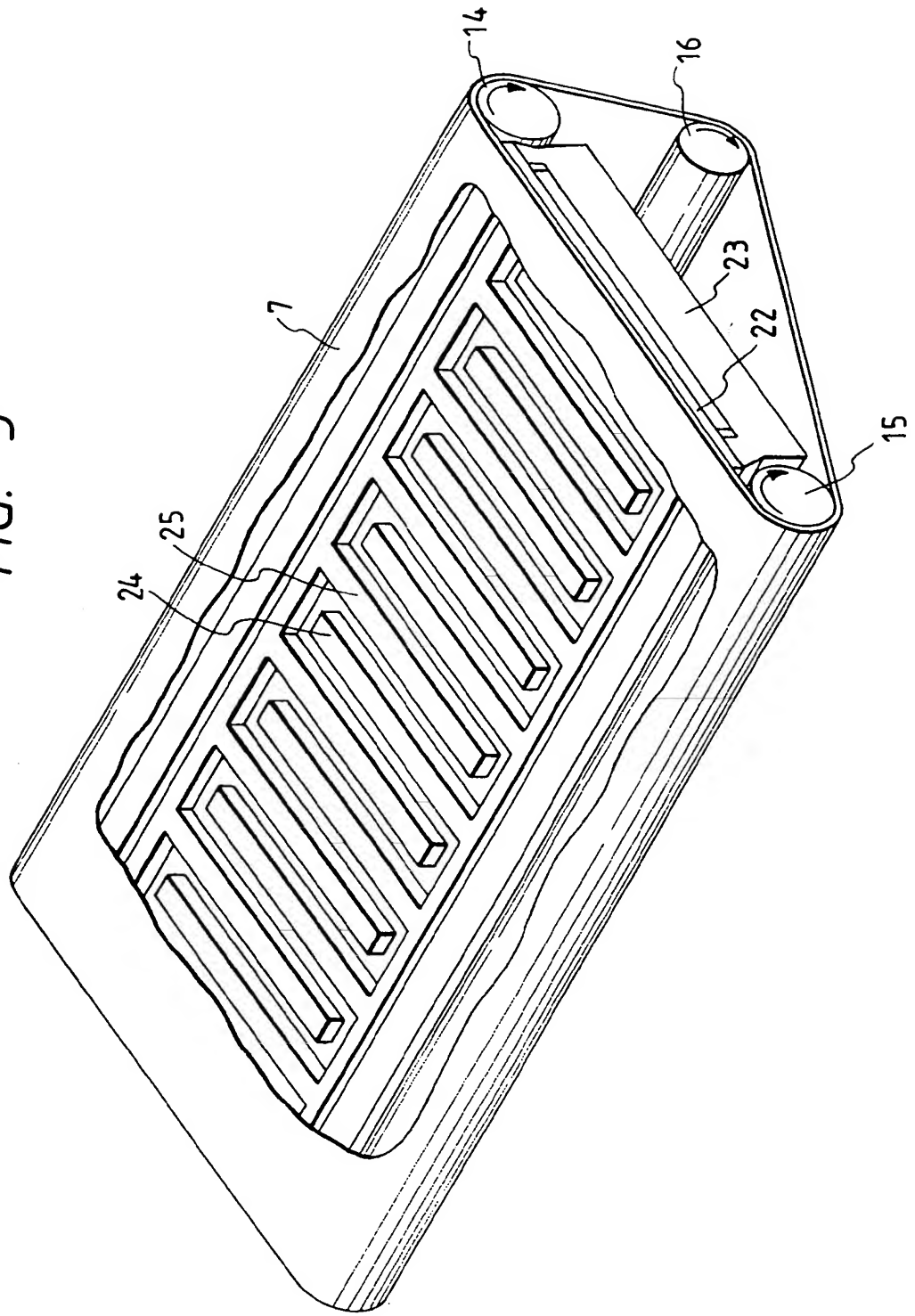


FIG. 3



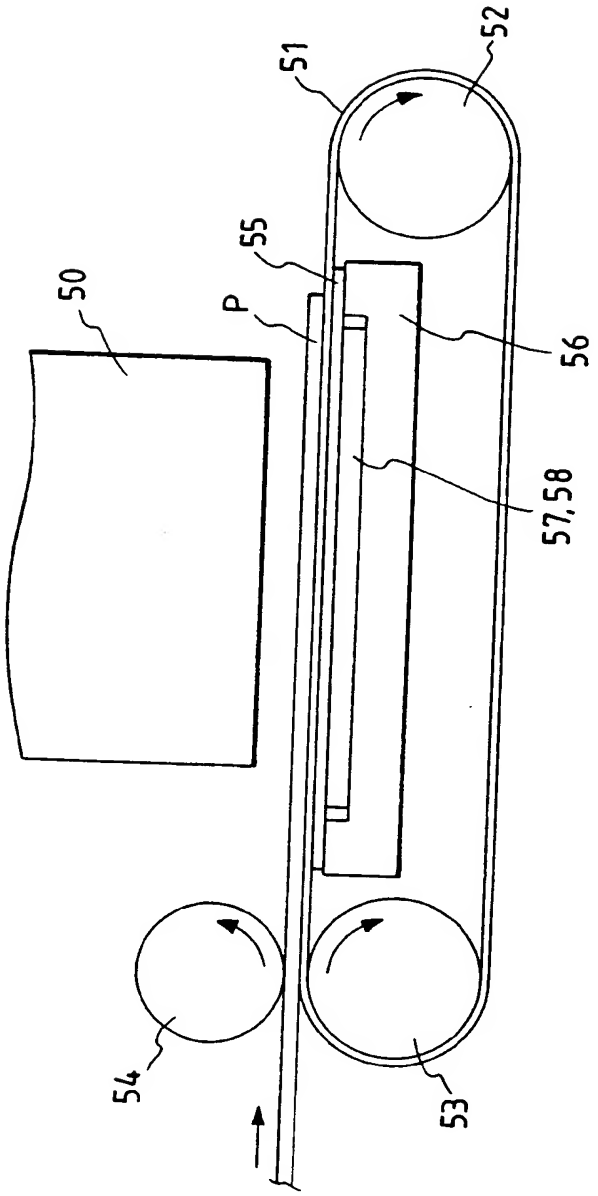


FIG. 4
PRIOR ART

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 10 9059

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	EP-A-0 535 914 (CANON K.K.) * column 7, line 29 - column 10, line 23; figure 1 *	1-13	B41J13/08
A	PATENT ABSTRACTS OF JAPAN vol. 15, no. 77 (M-1085) 22 February 1991 & JP-A-02 300 039 (RICOH CO LTD) 12 December 1990 * abstract *	1,9	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

B41J
B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	28 September 1995	De Groot, R

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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